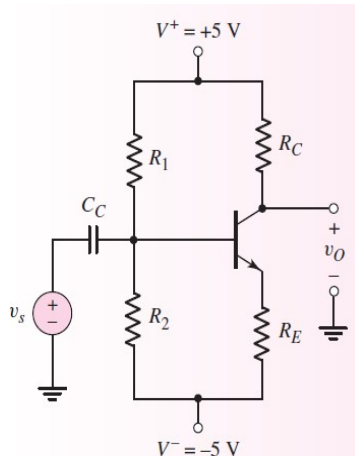David Kirby

**ECE322L -Homework 6 (100 points)**
**Assigned on Thursday, 03/05/2020-11 am**
**Due on Thursday, 03/12/2020-11 am**

Consider the circuit below. The transistor parameters are β = 150 and $V_{BE}$(on) = 0.7 V. The circuit parameters are $R_E$ = 2 kΩ and $R_C$ = 10 kΩ. Design a bias-stable circuit such that the quiescent output voltage is zero. What are the values of $I_{CQ}$ and $V_{CEQ}$?



$$I_{CQ} = \frac{V^+ - V_{out}}{R_C} = \frac{5 - 0}{10k\Omega} = \boxed{500\mu A}$$

$$I_E = (1 + \beta)\frac{I_C}{\beta} = (1 + 150)\frac{500\mu A}{150} = 503.33\mu A$$

$$V_{CEQ} = V_{out} - V^- - I_E R_E = 5V - 503.33\mu A \times 2k\Omega = \boxed{3.9933V}$$

$$V_{TH} = \frac{R_2}{R_1 + R_2} \times V_{CC} \quad \& \quad R_{TH} = R_1 \parallel R_2 \quad \rightarrow \quad V_{TH} = \frac{R_{TH}}{R_1} \times V_{CC} \quad \rightarrow \quad R_1 = \frac{R_{TH}}{V_{TH}} \times V_{CC}$$

$$R_{TH} = R_1 \parallel R_2 \approx 0.1 (1 + \beta) R_E = 0.1 (1 + 150) 2k\Omega = 30.2k\Omega$$

$$V_{TH} = V^- + V_{BE(on)} + R_{TH}I_B + I_E R_E = V^- + V_{BE(on)} + R_{TH}\frac{I_C}{\beta} + I_E R_E$$

$$= -5V + 0.7V + \left(\frac{500\mu A}{150} \times 30.2k\Omega\right) + (503.33\mu A \times 2k\Omega) = -3.1927V$$

$$R_1 = \frac{R_{TH}}{V_{TH} - V^-} \times (V^+ - V^-) = \frac{30.2k\Omega}{-3.1927V - (-5V)} \times (5V - (-5V)) = \boxed{167.10k\Omega}$$

$$R_{TH} = R_1 \parallel R_2 \quad \rightarrow \quad R_2 = \frac{R_1 \times R_{TH}}{R_1 - R_{TH}} = \frac{167.10k\Omega \times 30.2k\Omega}{167.10k\Omega - 30.2k\Omega} = \boxed{36.862k\Omega}$$